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**BEFORE THE BOARD OF PATENT APPEALS
AND INTERFERENCES**

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Application Number: 08/578,980
Filing Date: 12/27/95
Appellant(s): Kamakura

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Gregory J. Maier
For Appellant

EXAMINER'S ANSWER

This is in response to appellant's brief on appeal filed 1/28/99.

(1) Real Party in Interest

A statement identifying the real party in interest is contained in the brief.

(2) Related Appeals and Interferences

A statement identifying the related appeals and interferences which will directly affect or be directly affected by or have a bearing on the decision in the pending appeal is contained in the brief.

(3) Status of Claims

The statement of the status of the claims contained in the brief is correct.

(4) Status of Amendments After Final

The appellant's statement of the status of amendments after final rejection contained in the brief is correct.

(5) Summary of Invention

The summary of invention contained in the brief is correct.

(6) Issues

The appellant's statement of the issues in the brief is correct.

(7) Grouping of Claims

The rejection of claims do not stand or fall together because appellant's brief does not include a statement that this grouping of claims does not stand or fall together and reasons in support thereof. See 37 CFR 1.192(c)(7).

(8) Claims Appealed

The copy of the appealed claims contained in the Appendix to the brief is correct.

(9) Prior Art of Record

The following is a listing of the prior art of record relied upon in the rejection of claims under appeal.

4,984,242	Scifres et al.	1-1991
5,153,889	Sugawara et al.	10-1992
5,019,874	Inoue et al.	5-1991

(10) Grounds of Rejection

The following ground(s) of rejection are applicable to the appealed claims:

Claim Rejections - 35 USC § 102

1. The text of those sections of Title 35, U.S. Code not included in this action can be found in a prior Office action.

2. Claims 1, 3 and 5 are rejected under 35 U.S.C. 102(b) as being anticipated by Scifres et al.

3. With respect to claim 1, Scifres et al. describe a double hetero-structure LED (see Figure 2 and column 4, lines 13 - 30) with an AlGaAs clad layer 31, an undoped InGaAs active layer 29 and a second AlGaAs clad layer 25 which uses a strain layer 27 to prevent defect migration to the active region (column 1, line 44). Scifres et al. do not specifically state the thickness of the cladding layers but all Figures show the layers as being equal.

4. With respect to claim 3, the hetero-junction employs an undoped layer between two cladding layers.

5. With respect to claim 5, Scifres et al. discuss the use of a buffer layer (column 3, line 33).

Claim Rejections - 35 USC § 103

6. Claims 2 and 8 are rejected under 35 U.S.C. 103(a) as being unpatentable over Scifres et al. in view of Inoue et al.

7. With respect to claim 2, Scifres et al. show the use of a strain layer to prevent defect migration and discuss the use of a buffer layer (column 3, line 33), which is known to also limit defect migration and also discuss adding other strain layers (column 4, line 64). Inoue et al. discuss (see abstract) the use of multiple defect regions to limit defect migration and it would have been obvious to include a second strain layer as taught by Inoue et al. to supplement the buffer region.

8. With respect to claim 8, Scifres et al. discuss the basic device structure and refer to the strain layer thickness as being approximately 10 nm (column 4, line 47). Scifres et al. also discusses the lattice mismatch as being less than or equal to 4% (column 4, line 49). Inoue et al. discusses the defect density as being in the range of 10^6 /cm^2 which corresponds to a value greater than 10^4 /cm^2. It would have been obvious to provide the Scifres et al. device with the defect density taught by Inoue et al. to improve the defect protection.

9. Claim 4 is rejected under 35 U.S.C. 103(a) as being unpatentable over Scifres et al. in view of Sugawara et al.

10. Scifres et al. describe a double hetero-structure LED. Sugawara et al. discuss a LED structure which specifically calls out a current spreading layer 15 (cover Figure) and detail the use

of a buffer layer 32 (Figure 6). It would have been obvious to include the current spreading layer and the buffer layer to provide a more uniform output with improved reliability.

11. Claim 6 is rejected under 35 U.S.C. 103(a) as being unpatentable over Scifres et al. in view of Sugawara et al.

12. Scifres et al describe a double hetero-junction LED with clad layers enclosing an undoped region and having a strain layer to prevent defect migration. Sugawara et al. provide details of a buffer layer 32 (Figure 6), a current spreading layer 15 (cover Figure) and a reflective layer 33 (Figure 6). It would have been obvious to one skilled in the art at the time of the invention to include the current spreading layer, the buffer layer, and the reflective layers to improve device reliability and performance.

13. Claim 9 is rejected under 35 U.S.C. 103(a) as being unpatentable over Scifres et al. in view of Sugawara et al. and further in view of Inoue et al.

14. Scifres et al. describe a double hetero-junction LED with clad layers enclosing an undoped region and having a strain layer to prevent defect migration. Sugawara et al. provide details of a buffer layer 32 (Figure 6), a current spreading layer 15 (cover Figure) and a reflective layer 33 (Figure 6). Scifres et al. discusses the strain layer thickness as being approximately 10 nm (column 4, line 47). Scifres et al. also discusses the lattice mismatch as being less than or equal to 4% (column 4, line 49). Inoue et al. discusses the defect density as being in the range of 10^6 /cm^2 which corresponds to a value greater than 10^4 /cm^2.

15. Claims 5, 7 and 10 are rejected under 35 U.S.C. 103(a) as being unpatentable over Scifres et al. in view of Sugawara et al. and further in view of Inoue et al.

16. With respect to claim 7, Scifres et al. describe a double hetero-junction LED with clad layers enclosing an undoped region and having a strain layer to prevent defect migration. Sugawara et al. provide details of a buffer region, a current spreading region and a reflective layer. Inoue et al. describe the use of multiple defect controlling layers. It would have been obvious to modify the Scifres et al. device to include the current spreading layer, the details of the buffer layer, the reflective layers and a second layer as taught by Sugawara et al. and Inoue et al. to prevent defect migration and enhance the device output.

17. With respect to claim 5, Sugawara et al. describe the buffer layer as helping prevent defect migration (column 9, line 53).

18. With respect to claim 10, Scifres et al. discuss the strain layer thickness as being approximately 10 nm (column 4, line 47). Scifres et al. also discuss the lattice mismatch as being less than or equal to 4% (column 4, line 49). Inoue et al. discuss the defect density as being in the range of 10^6 /cm^2 which corresponds to a value greater than 10^4 /cm^2.

(11) Response to Argument

Applicant has presented arguments that include both new comments and a reproduction of old arguments and this response is primarily directed to the new arguments. For completeness the response to arguments of the last Office Action are presented at the conclusion of his section.

By way of introduction a number of facts related to light emitting device should be clarified.

In the growth of epitaxial layer of semiconductor materials using the technique of either MOCVD (Metal-Organic Chemical Vapor Deposition) or MBE (Molecular Beam Epitaxy) very fine control of the deposited material down to the level of single molecular layers is possible. What is not under the control of the growth process is the substrate on which the layers are grown. The substrate is derived from a grown crystal boule by the process of cutting and polishing. The resultant substrate surface is not perfect and includes dangling bonds, lack of planarity (on the molecular level), adatoms (foreign atoms) and residual crystal defects. To shield the epitaxial layers from such effects it is now standard practice to first grow a buffer layer which will shield the subsequent layers from the substrate effects.

Another effect seen is that for a surface emitting device, the electrode is kept small in diameter so as not to block the emitted radiation and the electrode is usually smaller than the emitting area. To allow the input current to reach the whole emitting area it is now common practice to include a relatively thick, high conductivity, layer immediately under the electrode to allow the current to spread out and reach all of the emitting area.

It is known that light emitting devices loose efficiency and eventually cease to emit light due to dark line and dark spot defects. These defects are thought to occur because crystal defects, which can move in the crystal, migrate to the active area. It is known that layers of material can be provided in a layered device which will getter these defects and prevent their

propagation to other regions. Thus by interposing these layers between the light emitting area and the potential sources of defects it is possible to increase the lifetime of light emitting devices.

The structure of a light emitting device will include an electron supply layer (n-type), an active layer (usually undoped) where electron hole recombination occurs and light is generated and a hole supply layer (p-type). The electron and hole supplying layers are referred to as the cladding layers and in the case where they are not the same material as the active layer (such as GaAlAs clad layers with a GaInAs active layer) the structure is referred to as a double heterostructure. The clad layers must be thick enough to provide all the carriers that can potentially combine to produce light and if too thin would limit the emission. Note that if the layers are too thick, some of the charge would not be able to reach the active region before combining, and the extra width is a burden on the process.

Following is a discussion of Applicant's arguments.

Applicant makes a great issue over whether the Scifres structure qualifies as a hetero-configuration with a dense defect region between it and the electrode. Note that Scifres shows a strain layer, of InGaAlAs, which is described as being in the cladding layer. The purpose of this layer is to stop defect migration to the active area. Note that there is clad layer material between the strain layer and the active layer, which means that the strain layer is outside the hetero-configuration, as claimed. Applicant also states that the strain layer cannot protect the portion of the clad layer outside, but while that is true, it is immaterial, for it is the inner

region where the active area is that needs protection. Applicant argues that the Examiner incorrectly stated that the strain layer protects the active layer and did not say that it protects the hetero-configuration but note that it is the active region that must be protected and defects in the clad region would be relatively innocuous if they didn't migrate to the active layer. Applicant also states that Scifres has no hint of adding indium to provide a material to cooperate to prevent crystal defects from reaching the hetero-configuration, but this is exactly what Scifres has. It should also be noted that a strain layer has crystal atoms out of their normal equilibrium position and this is effectively a lattice defect.

Applicant has raised a non issue in stating that the examiner is ignoring the specification. Reference is made to the fact that the examiner took exception to applicant's arguments and stated that the structure claimed was the structure that was shown in the prior art, which is sufficient for a rejection.

Applicant still argues the interpretation of the location of the strain layer and says that the artisan would interpret the strain layer as part of the clad layer. As was noted above this is contrary to fact and is probably due to a misunderstanding of the structure of the strain layer. Note that for a strain layer to function it must show strain by contrast of its lattice constant to the surrounding areas. Thus for a strain layer to be effective it must be enclosed in a three layer sandwich, exactly as Scifres shows.

At the top of page 10 of the appeal brief the Applicant states that "...the examiner appears to rely upon the roosed reading of only part of the overall cladding layer as the

cladding layer resulting in an unwarranted "conjectural modification"...". This is not understood and is not responded to.

Applicant states that Scifres does not discuss a buffer layer but only mentions it. This is true but it is Sugawara that is relied upon for the teaching of a buffer layer. Thus the argument is moot but note also that it is well known in the art to use a buffer layer and Sugawara is given as one source of that knowledge. Applicant also questions the discussion of Scifres concerning the buffer layer on the bottom of page 11 of the Appeal brief which is also moot.

Applicant takes exception to the use of Inoue in the quotation of the source as the abstract but the same data is contained in the body of the patent. Applicant seems to feel that not all the details of Inoue are pertinent to the rejection but note that Inoue is relied upon for the teaching of multiple defect regions. Therefore arguments concerning other aspects of Inoue are moot.

Applicant raises the issue of whether Scifres shows the two clad layers as being of equal thickness and Applicant seeks to interpret Scifres as showing that the upper clad is one micron and the lower clad is one half micron thick and that this does not meet the claims. First note that criticality had not been established and one micron is clearly of the same order as one half micron. Second, note that the requirements on the thickness of the cladding layers depend on the ability of the carriers to reach the active region through diffusion and drift. Since the p-clad and n-clad layers do not have the same carrier densities and the same doping species, the mobility of the carriers in each of the two regions will be different which will result in

different electric field intensities. For these reasons, there is no reason to make the widths identical. All that can be said is that they are of similar magnitudes. Note also that Scifres states that the clads are typically one micron thick (column 3, line 55) referring to Figure 1 and also states that the strain layer is typically at least a half micron away from the active layer. Thus the Scifres layer thicknesses meet the claim values.

Applicant argues against features of Scifres that are not in issue and discusses the stain layer sequence shown in Figure 3 (two strain layers directly in contact with the active layer) but note that it is the structure that is shown in Figure 2 that is applied to the rejection and the discussion of Figure 3 is entirely moot.

Applicant again argues that the details of Inoue are not all pertinent but as noted above this is moot. Applicant also argues that Scifres and Inoue can't be combined since they do not discuss the same subject matter but without getting into a discussion of the relative crystallography note again that Inoue is not relied upon for the details of his teachings, only that part noted above. Inoue is relied upon to teach a comparative value of defect densities which is proper since it indicates the level of defects that can be encountered.

Applicant confuses examiners argument and states that the spreading layer does not improve reliability. But what was stated was that Sugawara was combined with Scifres to show a buffer layer and a reflective layer and the second defect preventing layer was taught by Inoue. Reliability is enhanced by providing the strain layer and the buffer layer while the

output is enhanced by providing the spreading layer and the reflecting layer. This is clearly stated.

Applicant states that just because the spreading layer and the buffer layer are known in the art doesn't mean that they can be applied and asks for case law. This is not understood. If something is known in the art it is assumed known to all practitioners in the art. Note the rejection quoted the relevant potion of 103.

Applicant argues that Scifres and Sugawara and Inoue can't be combined but note that the combination of the three references shows all the claimed features and there is justification for combining them.

Prior Response to Arguments

19. Applicant argues that Scifres et al. do not show the claimed structure since the strain layer is in the clad layer. Note however, that the strain layer has a different composition from the clad layer and therefore qualifies as a separate layer. Applicant also states that Scifres et al. cannot be read on the claim since it doesn't agree with the specification. Nevertheless, Scifres et al. do show the claimed structure regardless of what is in the specification.

20. Applicant argues that Scifres et al. discuss the clad layers as having a typical thickness of 1 micron and quotes the Scifres et al. statement that the strain layer must be at least 0.5 microns away from the active layer to mean that the clad layer would thus be reduced to a non equal thickness. Note however that Scifres et al. only quote a minimum thickness to prevent

interference with the bandgap of the active layer and in no way imply that the clad layers have unequal thickness. In fact, Figure 2 shows the clad layers 25 and 31 as having the same thickness.

21. Applicant argues that Inoue et al. cannot be combined with Scifres et al. but the combined teaching is for multiple defect regions and since they are both part of the prior art and their teachings show benefits it is entirely proper to combine their teachings.

22. Applicant argues that Inoue et al. cannot be used to show a defect density of 10^6 /cm^2 since it is not shown in the abstract. Note however that is shown elsewhere in Inoue et al. (column 4, line 34).

23. Applicant argues that Sugawara et al. do not cure deficiencies of Scifres et al. Yet, Scifres et al. and Inoue et al. show the basic claimed structure and Sugawara et al. is relied upon to teach the use of a buffer layer on a substrate, a current spreading layer and a reflective layer which all have well documented benefits.

For the above reasons, it is believed that the rejections should be sustained.

Respectfully submitted,

DAW
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